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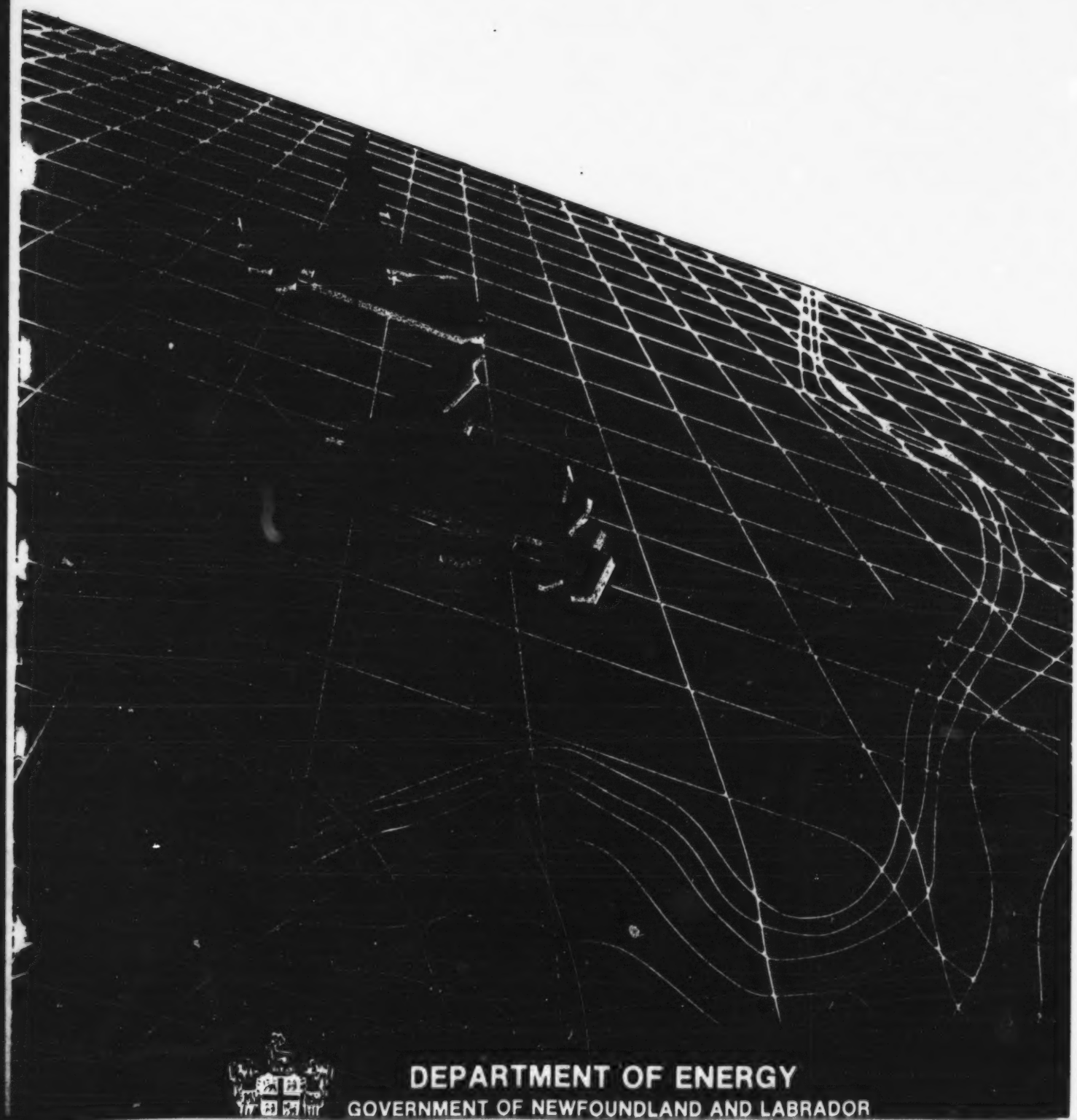
OF NEWFOUNDLAND AND LABRADOR



DEPARTMENT OF ENERGY
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

OIL AND GAS RESOURCES
OF NEWFOUNDLAND AND LABRADOR

Published under the Authority of
The Honourable A. Brian Peckford, P.C.
Minister of Energy
Government of Newfoundland and Labrador
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F O R E W O R D

As the provincial energy minister, I am particularly pleased to introduce the Oil and Gas Resources of Newfoundland and Labrador. Its main purpose is to provide the reader with information about petroleum exploration and development in the Province, to outline the importance of the oil and gas resource which lies in the Newfoundland continental margin and to summarize recent events which relate to the future of the Province's tremendous potential to contribute to the nation's petroleum supply.

The policy objectives of the Government of Newfoundland and Labrador with respect to the development of its petroleum resources were first set out in detail in the 1977 White Paper issued when I was Minister. In summary these objectives called for the maximizing of benefits for our people and the minimizing of all associated negative impacts. They also called for provincial control of the management and rate of development of the resource. After a number of years of dispute with the federal government over the question of jurisdiction, the province's objectives were substantially achieved by the Atlantic Accord of February 1985 with the present federal government.

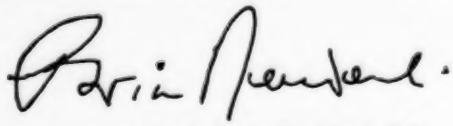
While I must confess to some bias, having been closely involved over the last decade in the efforts of the Government of Newfoundland and Labrador to encourage the development of our offshore resource, and to achieve its fundamental objectives, I am convinced that the momentum to exploit the oil that lies under the Grand Banks is strengthening. While the world price of oil represents a major constraint on offshore development investment, and seems likely to remain so for some time, I believe that the strong cooperative bonds that have developed between the federal and provincial governments over the last few years represent a positive new influence which will greatly assist our efforts to persuade the oil industry to move ahead with its exploration and development plans. The on-going negotiations between the Government of Canada and the Government of Newfoundland and Labrador with Mobil Oil Canada, Ltd. and its partners in the Hibernia project reflect to a considerable extent the intention of both governments to share in the risks of offshore oil development in these uncertain times.

There is little doubt that Canada has need to add to its indigenous oil supplies. The 1987 reports of the National Energy Board and of the House of Commons Standing Committee on Energy highlighted the steady depletion of the nation's reserves of conventional light crude oil in the western provinces. While there are immense longer term petroleum supplies in the western tar sands and additional reserves in the Arctic which will eventually be developed, these projects have not progressed as far as Hibernia – a project which is ready to go now.

"...the momentum to exploit the oil that lies under the Grand Banks is strengthening...."

The ongoing national debate on energy security, the decreasing capacity of the non-OPEC countries to add to their oil supplies and the ever-present possibility of major oil supply disruption due to events in the Middle East, lend urgency to Canada's need for timely action to improve its oil security.

Hibernia, Terra Nova, Whiterose and other promising discoveries on the Grand Banks, have the potential to add substantially to the oil security of Canada in general and to that of the highly vulnerable eastern region in particular. The scale of these projects makes them important not only from the standpoint of national energy security but also in terms of the stimulus which they will give to the provincial and regional economies at this time when it is so badly needed. I am particularly pleased with the immediate benefits which are being derived from the use of the Canada-Newfoundland Offshore Development Fund. The projects which have been approved to date under this program will add tremendously to the Province's ability to take advantage of the many economic and employment opportunities associated with offshore petroleum exploration, development and production. They will greatly improve the capabilities of our centres of learning and develop Newfoundland expertise in the highly sophisticated sphere of offshore petroleum technology. The use of the Fund to provide new related infrastructure and to enhance our existing industrial facilities will advance the Province's claims for the local undertaking of a wide range of petroleum-related industrial activities.



Honourable A. Brian Peckford, P.C.
Minister

For administrative purposes, legislation and regulation of petroleum exploration, development and production in the Province differs according to whether the activity takes place in the offshore or onshore areas. The offshore region of the Province is administered jointly by the Governments of Newfoundland and Labrador and of Canada through the Canada–Newfoundland Offshore Petroleum Board (CNOPB); all operations onshore are under the sole jurisdiction of the provincial government.

OFFSHORE

THE ATLANTIC ACCORD

The Atlantic Accord, a memorandum of agreement between the Government of Canada and the Government of Newfoundland and Labrador on offshore oil and gas management and revenue sharing, was signed on February 11, 1985. The Accord ended many years of dispute between the two governments on the subject of control of offshore petroleum resources, and represents a milestone in the history of federal/provincial relations.

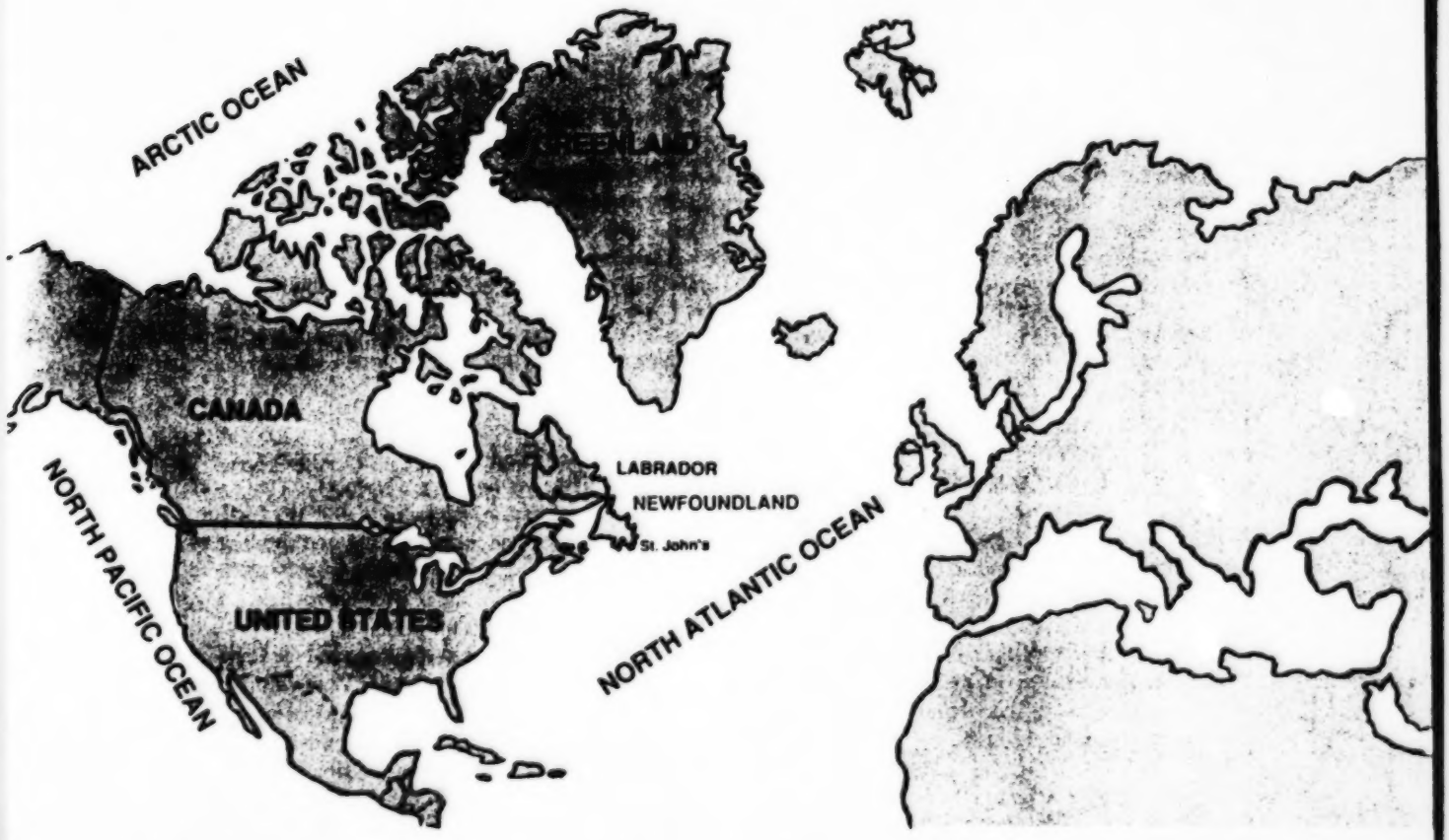


FIGURE 1. GENERAL LOCATION OF NEWFOUNDLAND AND LABRADOR

The purposes of the Accord are:

- to provide for the development of oil and gas resources offshore Newfoundland for the benefit of Canada as a whole and Newfoundland and Labrador in particular;
- to recognize the right of Newfoundland and Labrador to be the principal beneficiary of the oil and gas resources off its shores, consistent with the requirement for a strong and united Canada;
- to protect, preserve, and advance the attainment of national self-sufficiency and security of supply;
- to recognize the equality of both governments in the management of the resource, and ensure that the pace and manner of development will optimize the social and economic benefits to Canada as a whole and to Newfoundland and Labrador in particular;
- to provide that the Government of Newfoundland and Labrador can establish and collect resource revenues as if these resources were on land, within the Province;
- to provide for a stable and fair offshore management regime for industry;
- to provide for a stable and permanent arrangement for the management of the offshore adjacent to Newfoundland by enacting the relevant provisions of this Accord in legislation of the Parliament of Canada and the Legislature of Newfoundland and Labrador and by providing that the Accord may only be amended by the mutual consent of both governments; and
- to promote within the system of joint management, insofar as is appropriate, consistency with the management regimes established for other offshore areas in Canada.

THE CANADA-NEWFOUNDLAND ATLANTIC ACCORD IMPLEMENTATION (NEWFOUNDLAND) ACT (1987)

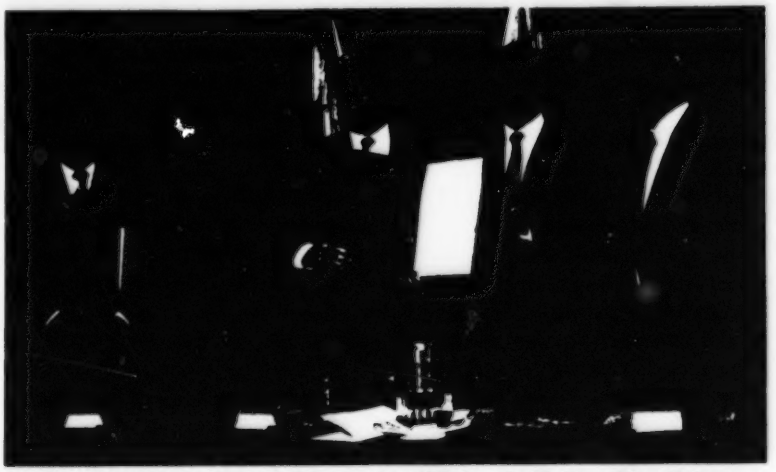
Legislation implementing the Atlantic Accord, the Canada–Newfoundland Atlantic Accord Implementation (Newfoundland) Act, received Royal Assent on June 17, 1986 and was proclaimed in force on April 4, 1987. Its federal counterpart, the Canada-Newfoundland Atlantic Accord Implementation Act was proclaimed simultaneously.

This comprehensive Act provides the legislative setting for all aspects of the control and management of the offshore resource.

"The Atlantic Accord represents a milestone in the history of federal/provincial relations."

Management of the Resource

The two governments share equally the responsibility for the management of the resource which is undertaken through the medium of a joint agency, the Canada-Newfoundland Offshore Petroleum Board. However the provincial government has final approval over decisions relating to the choice of mode of development and it has the right to establish and collect revenue as if the resources were located on land within the Province. The federal government has final approval on the pace and mode of exploration and the pace of development until such time as national self sufficiency in oil is achieved. National self sufficiency is defined in the Accord as being achieved in any calendar year when the volume of suitable crude oil and equivalent available from Canadian hydrocarbon productive capacity is sufficient to meet the feedstock requirements of Canadian refineries that are necessary to meet the refined petroleum product needs of Canada.



Signing of the Atlantic Accord, February 11, 1985, by the Rt. Hon. Brian Mulroney and the Hon. A. Brian Peckford. Also present, from left to right: the Hon. John Crosbie, the Hon. Pat Carney, and the Hon. William Marshall.

Energy, Mines and Resources Canada

Department of Energy

The Department of Energy provides advice to the provincial government related to the exploration, development, production, transportation, processing and refining of the petroleum resources in both the offshore and onshore areas of the Province. The Department is the principal liaison between the provincial government and the Canada-Newfoundland Offshore Petroleum Board and the federal government. As principal advisor to the government it monitors and interprets industry activity, provides assessments of decisions taken by the CNOPB and is involved with the planning and development of relevant oil and gas legislation and regulation.

The Canada-Newfoundland Offshore Petroleum Board

The Board is responsible for the administration of the offshore petroleum resource on behalf of both governments. Its responsibilities are explicitly set out in the Atlantic Accord Implementation Acts which empower the Board to make most decisions related to the management of the offshore oil and gas resources. These decisions include the administration of regulations relating to good oilfield practice, the granting of production licences, the exercise of emergency powers and the declaration of significant discoveries.

Certain decision areas referred to as "fundamental", which primarily affect the pace and mode of exploration and development, the pace of production and the exercise of extraordinary powers, also fall within the domain of the Board but these are subject to the final approval of both governments. These fundamental decision areas include the issuance of rights such as the calling for bids and the setting of terms and conditions of Exploration Agreements, certain extraordinary requirements such as directing an interest holder to drill a well, to alter production, or to act to prevent waste. They also include final approval of development plans.

The Board, which consists of three members nominated by the federal government, three members nominated by the provincial government and a chairman jointly appointed by both governments, is mandated to make its decisions by consensus and to operate independently. It is required to keep both governments informed of developments.

Fiscal Aspects

The provincial government has the authority to administer resource revenue from development of the offshore resources as if they were located on land. These revenues will include provincial corporate income tax, sales tax, rentals and licence fees. They will also include royalties.

TABLE 1. PROJECTS UNDER THE OFFSHORE DEVELOPMENT FUND

Approved to Date	
Centre for Earth Resources Research (Memorial University)	$25,000,000
Offshore Survival Centre (Marine Institute)	5,000,000
Skills Training Projects (Dept. of Career Development and Advanced Studies)	3,000,000
Computer Aided Design Facility in Engineering (Memorial University)	1,150,000
Career Development Awards Program (Dept. of Career Development and Advanced Studies)	3,000,000
Centre for Offshore and Remote Medicine and Telemedicine (Memorial University)	2,700,000
Centre for Cold Ocean Resources Engineering (C–Core Memorial University)	5,000,000
Centre for Excellence in Marine Signal Processing (NORDCO)	7,400,000
Offshore Technology Transfer Opportunity Program (Dept. of Development)	3,000,000
Petroleum Technology Training Program (Dept. of Career Development and Advanced Studies)	21,100,000
Industrial Infrastructure Planning (Dept. of Development)	1,300,000
Enhancement of Offshore Fabrication Capability Marystown Shipyard (Dept. of Development)	2,000,000
Access Road to Cow Head Oil Rig Repair Facility (Dept. of Transportation)	663,000
Administrative Support, Canada–Newfoundland Offshore Development Fund Committee	500,000
Wave Generator (Institute of Marine Dynamics)	3,500,000
Marine Offshore Simulator Training (MOST) Centre (Marine Institute)	12,000,000
Super Puma Helicopter Flight Simulation Centre (Canadian Helicopter Corp)	4,200,000
Newfoundland Science and Technology Advisory Council	500,000
Multi-Phase Flow Meter (Nortek Engineering Instrumar)	219,192
Feasibility Study–Concrete Floating Production Vessel (Bouygues Offshore and Assoc.)	869,912
Subtotal	$102,102,104
Approved in Principle	
Research and Development Block Fund	3,410,896
Enhancement of Offshore Fabrication Capability of Marystown Shipyard	18,000,000
Subtotal	$22,500,000
Total	$123,513,000

The federal government will be entitled to receive federal corporate income tax and all other revenues which may be established under federal jurisdiction.

The fiscal arrangements agreed to in the Atlantic Accord contain certain equalization provisions which recognize that the Province should not experience a dollar for dollar loss of equalization payments as a result of offshore revenues flowing to the Province.

Benefits Aspects

The Atlantic Accord recognized the right of Newfoundland to be the principal beneficiary of the oil and gas resources off its shores, consistent with the requirement for a strong and united Canada. A separate memorandum of understanding between both levels of government and the Board is being finalized which will set out agreed guidelines on industrial and employment benefits.

All development plans will contain a Canada-Newfoundland benefits plan which will ensure that, consistent with the Charter of Rights, residents of the Province shall be given first consideration for training and employment in the work program. First consideration will also be given to supplies and services from within the Province where these are competitive in terms of price, quality and delivery. This broad principle will also apply to research and development.

The Government has assigned high priority to Offshore Development Fund projects which give long term benefits to the Province.

Offshore Development Fund

On February 11, 1986, the Government of Canada and the Government of Newfoundland and Labrador signed an Offshore Development Fund Agreement. The Fund consists of $300 million and is cost-shared 75 percent by the federal government and 25 percent by the Province. To date some $123.5 million have been approved for projects to be financed out of the Development Fund. The main projects to date are described in more detail in Appendix B.

The purpose of the Fund is to contribute to the infrastructure costs related to the development of oil and gas in the offshore area before production begins so that the Province will be well equipped to reap the economic and social benefits of offshore development.

Within its broad strategy for use of the Fund, the Government of Newfoundland and Labrador has assigned a high priority to projects which will give major long-term economic benefits to the Province. Generally, these include education and training projects aimed at providing better opportunities for Newfoundlanders to participate in oil and gas exploration, development and production activities. They also encompass research and development in petroleum-related fields which will lead to the development of greater local technical expertise in the offshore. Infrastructure required to enable a specific industrial site to be utilized in support of oil development has also been designated a priority where its absence would preclude the Province from being considered as a development site for various petroleum-related industrial activities.

Associated Legislation and Regulation

A number of legislative and regulatory changes have resulted from the Atlantic Accord and the subsequent Implementation Acts. These are outlined in Appendix A.

ONSHORE

THE PETROLEUM & NATURAL GAS ACT (1970)

In those areas subject solely to provincial jurisdiction, the Petroleum and Natural Gas Act (1970) sets out the procedures which apply for petroleum exploration and production. It also outlines the regulatory powers of the provincial government with respect to land tenure, exploration, production, rental fees, royalties and reporting requirements.

Recent amendments to this act recognize the provisions of the 1985 Atlantic Accord and provide for the establishment of a royalty system by the provincial government. The Act to Amend the Petroleum and Natural Gas Act was given Royal Assent on June 17, 1986 (Chapter 40, RSN, 1986) but has not yet been proclaimed.

II THE GEOLOGICAL SETTING

OFFSHORE

The offshore region of Newfoundland and Labrador covers an area of approximately 185 million hectares.

Geophysical surveys conducted by research institutes and government in the 1950's indicated the region had all the pre-requisites for a major petroleum province. As a result, the petroleum industry started exploration in the region.

FIGURE 2. NEWFOUNDLAND CONTINENTAL MARGIN

This exploration has defined several basins which were sites of thick Mesozoic and Cenozoic sediments. These basins formed as North America separated from Europe and Africa approximately 200 million years ago. This separation later resulted in the opening of the present day Atlantic Ocean through processes known as continental drift and sea floor spreading. The Grand Banks records about 225 million years of basin formation and subsidence while the Labrador Shelf records approximately 135 million years.

The Jeanne d'Arc Basin (also known as The Avalon Basin), which is the site for the Hibernia Field, and most of the subsequent hydrocarbon discoveries, originated from this Mesozoic tectonic episode. This basin contains up to 14 kilometres of sedimentary rock and is bounded by prominent faults. The basin plunges to the north and contains a variety of sedimentary rocks reflecting changing conditions as the basin evolved.

The earliest sediments in the basin were sandstones and shales, but continued subsidence resulted in extensive salt deposits, carbonates, sandstones and shales. Later sedimentation proved to be an important event in the basin's history, for during the Late Jurassic an organically rich shale was deposited throughout the basin. The organic material within this shale is the major source of the hydrocarbons that are being discovered in this area today. A major change in sedimentation occurred during the Late

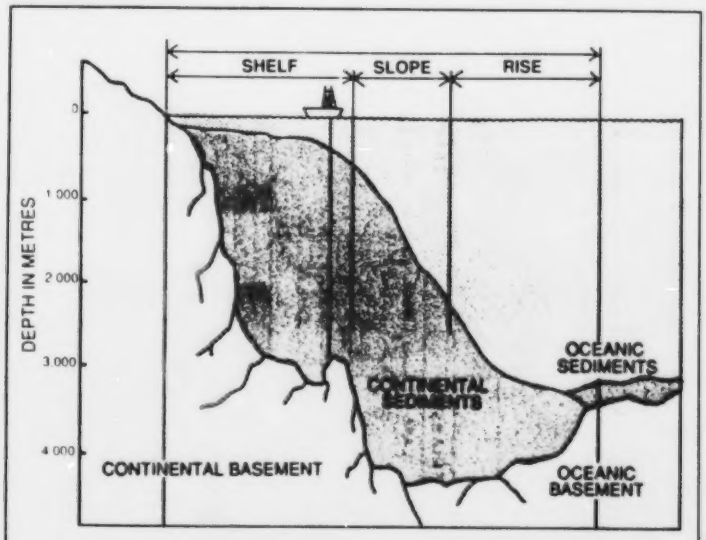


FIGURE 3. CONTINENTAL MARGIN SECTION

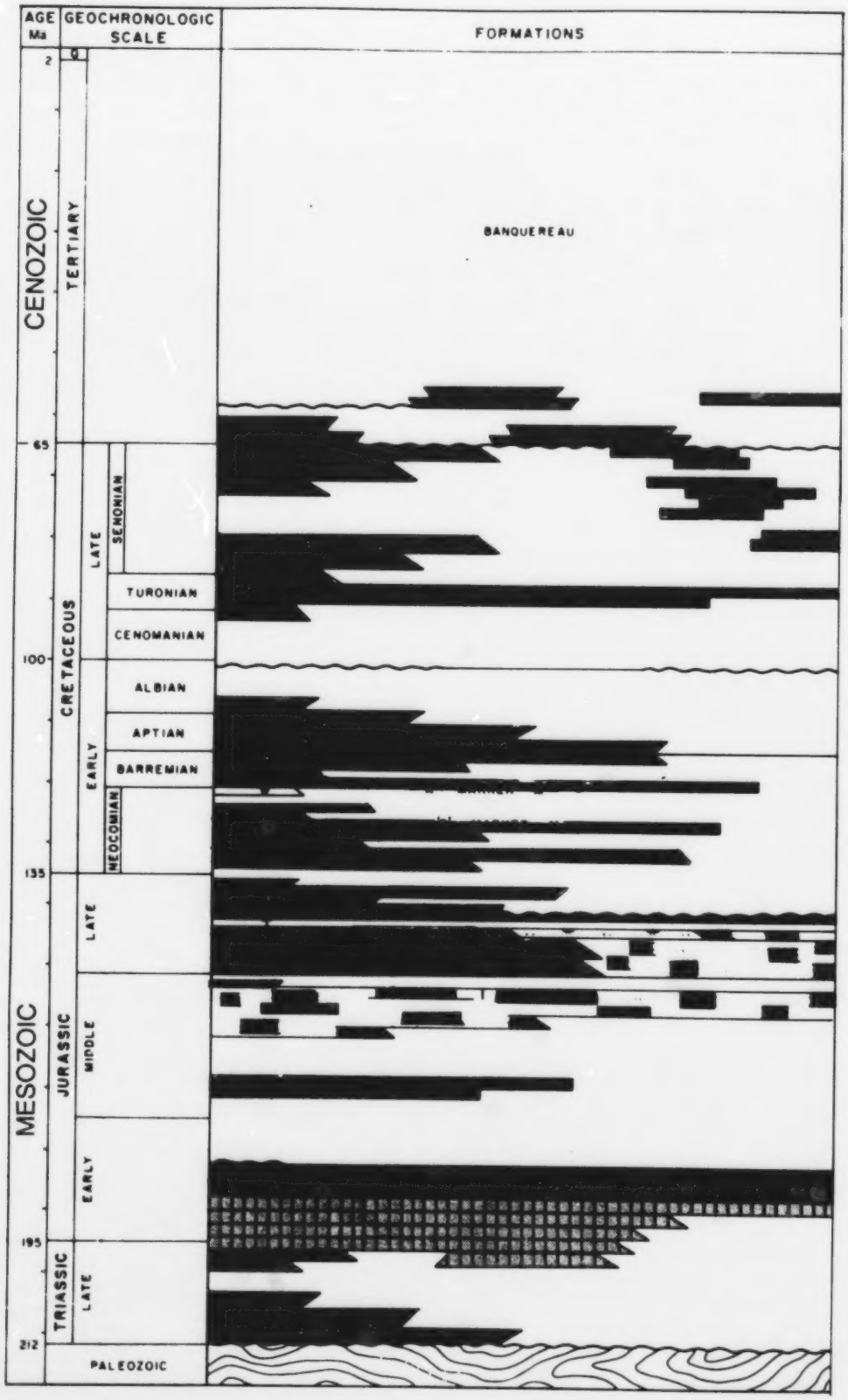


FIGURE 4. JEANNE d'ARC BASIN LITHOSTRATIGRAPHY

Jurassic and Early Cretaceous in response to localized elevation of portions of the Grand Banks. These uplifts were eroded and shed debris into the actively subsiding basin. This debris formed the sandstone reservoirs which are the principal hydrocarbon intervals within Hibernia and many of the other significant discoveries noted in the basin. This important period in basin evolution was interrupted by further uplifts resulting in a major re-structuring of the previously deposited sediments. Upper Cretaceous to Tertiary sedimentation is characterized by shales with sandstone and minor limestone.

The principal structural controls on trap formation were the periods of relative subsidence of the basin with faulting. The secondary effects were salt flowage which is evidenced by the salt accumulations occurring within the central portion of the basin. Faulting is widespread and most hydrocarbon accumulations are in some way fault-related.

Hydrocarbon discoveries have been made in both carbonate and sandstone reservoirs with ages varying from Paleozoic to Tertiary. The more significant oil and gas discoveries are associated with down-to-basin faults or cross-fault trends that occur within the Jeanne d'Arc Basin.

It is relevant to note that the Grand Banks have many of the geologic characteristics observed in the North Sea. The distribution of the North Sea oil and gas fields is closely linked with a major rift system as is the case in the Newfoundland region. The hydrocarbon-bearing reservoirs of the North Sea and the Grand Banks discoveries are of similar age.

In contrast to the North Sea, however Newfoundland's offshore is relatively unexplored; the total number of wells drilled off Newfoundland between 1966 and 1987 is equivalent to the number of wells being drilled annually in the North Sea in recent years.

History of Offshore Petroleum Exploration Since 1965

Preparations for offshore drilling began in 1965 and since then operations have been conducted at 130 locations on the continental margin of the Province. In 1966, Amoco and Imperial Oil drilled the first wildcat well offshore Newfoundland. Pan Am Imperial Tors Cove D-52 encountered minor shows of methane during formation testing. Shortly afterward, a second well, Pan Am Imperial Grand Falls H-09 was spudded 171 kilometres to the northeast. The well was abandoned after failing to encounter hydrocarbons.

Sean O'Brien

Sean O'Brien

Stratigraphic similarities of rocks of Bell Island, Newfoundland (left photo), and the Bay of Biscay, (above).

The Geological Survey of Canada has estimated that the Newfoundland continental margin may contain up to 10 billion barrels of recoverable oil.

Subsequently, all drilling was halted for a four year period and efforts were concentrated on the acquisition of reflection seismic data.

In 1971, drilling resumed on the Grand Banks and was initiated on the Labrador margin. By the end of 1974, forty wells had been drilled with only one significant oil show having been made at Mobil Gulf Adolphus 2K-41 on the northern Grand Banks. Four wells had been drilled on the Labrador

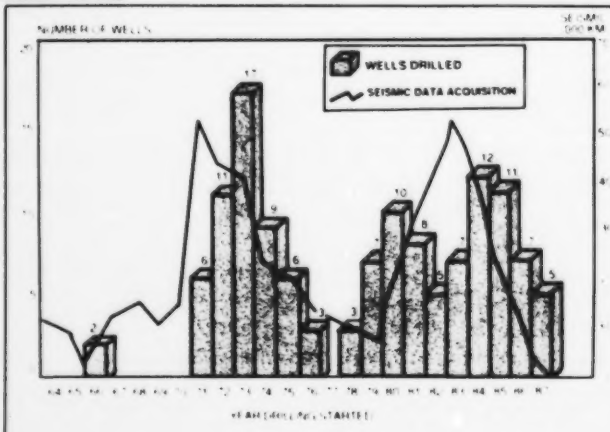


FIGURE 5. EXPLORATION ACTIVITY, TOTAL CONTINENTAL MARGIN

margin during this period which resulted in two gas discoveries by Eastcan et al (Bjarni H-81 and Gudrid H-55). This lack of success in finding large oil reserves, coupled with escalating drilling costs and the federal/provincial jurisdictional dispute, brought activity to a low level for several years.

In 1979, Chevron Standard, as part of a farm-in arrangement with Mobil Oil Canada, Ltd., spudded the Hibernia P-15 well. With an estimated flow potential of more than 20,000 barrels of oil per day from one well, Hibernia turned out to be the first structure drilled on the Atlantic shelf of North America thought to be capable of commercial production. Under the terms of the farm- out agreement, Mobil assumed operatorship of the field. The discovery of this giant oilfield, coupled with various incentive programs, provided the necessary stimulus to reactivate exploration operations. Since 1980, new well starts have ranged between five and twelve per year, with an average of eight per year. Seismic data acquisition also increased with record amounts in 1982 and an annual average of approximately 31,000 line kilometres since 1980.

Prior to the Hibernia discovery, drilling activity was concentrated on the southern Grand Banks and the Labrador Shelf. Thereafter the industry focussed its exploratory effort on prospects occurring on the northern Grand Banks. This exploration activity resulted in several significant discoveries and consequently, the industry increased its programs in the region. Petro-Canada spudded the Terra Nova K-08 well in 1983 and encountered a major oil-bearing reservoir. Testing confirmed the importance of this zone and analysis of the test results show that the well has a productive capacity of 15,000 barrels of oil per day.

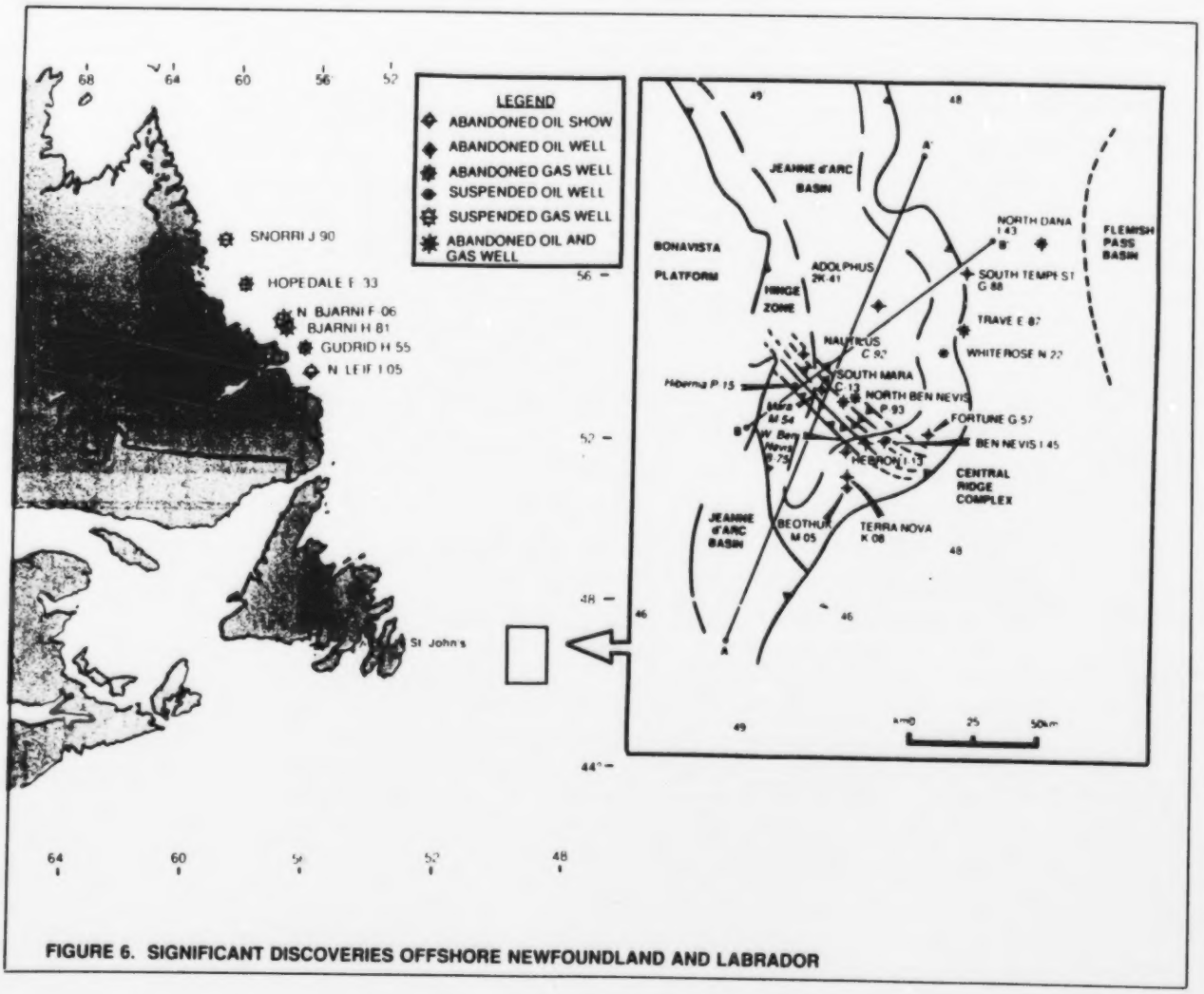


FIGURE 6. SIGNIFICANT DISCOVERIES OFFSHORE NEWFOUNDLAND AND LABRADOR

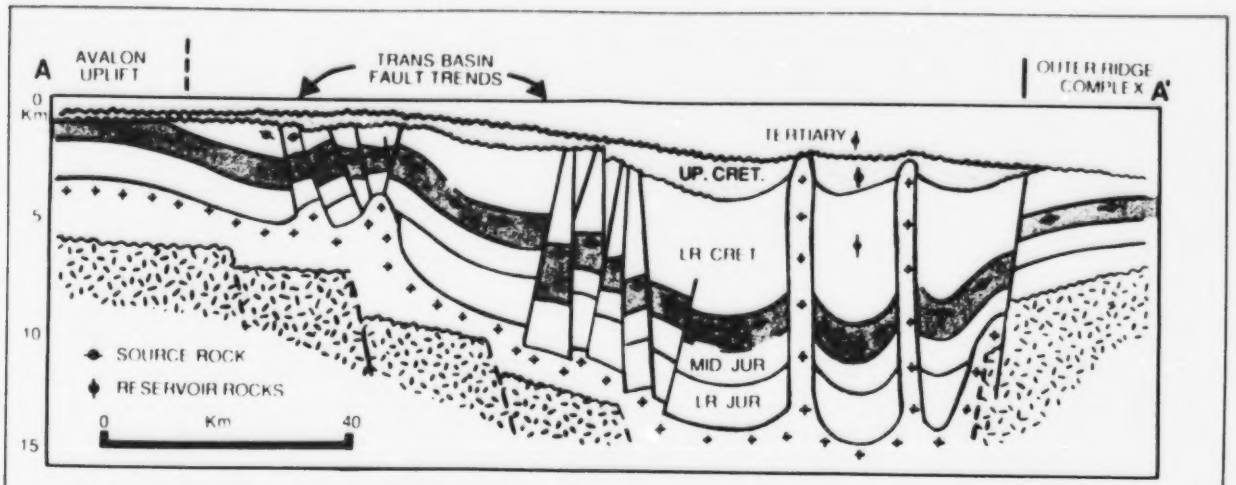


FIGURE 7. SECTION A–A' THROUGH THE JEANNE d'ARC BASIN (SEE FIGURE 6)

Grant, McAlpine and Wade

Recent Drilling Operations Offshore

Three operators, Husky/Bow Valley, Northcor Energy Ltd., and Petro-Canada have been active in drilling during the last two years.

Husky/Bow Valley, using the Bow Drill 3, completed drilling at Golconda C-64, drilled Bonne Bay C-73, re-entered and tested North Ben Nevis M-61 and began drilling Whiterose E-09.

Northcor Energy Ltd. contracted the Sedco 710 drilling unit to drill the Northcor et al Narwhal F-99 well during July to September of 1987. The well, located in the South Whale Basin on the southern edge of the Grand Banks in 1,577 metres of water, set a new Canadian deep water drilling record. Petro-Canada, also operating the Sedco 710, drilled and tested the Terra Nova H-99 well, drilled the Terra Nova C-09 well and spudded the Terra Nova E-79 location. These operations were intended to delineate the extent of the promising Terra Nova oil discovery.

TABLE 2. NEWFOUNDLAND OFFSHORE OPERATOR–HELD INTERESTS AND DRILLING COMMITMENTS

Interest Owner	Hectares	Wells Req'd to Hold
Mobil Oil Canada	423,573	5
Shell Canada	228,826	1
Petro-Canada	32,412	1
Labrador Group	25,185	–
Canterra	2,900	–
Total	**712,896**	**7**

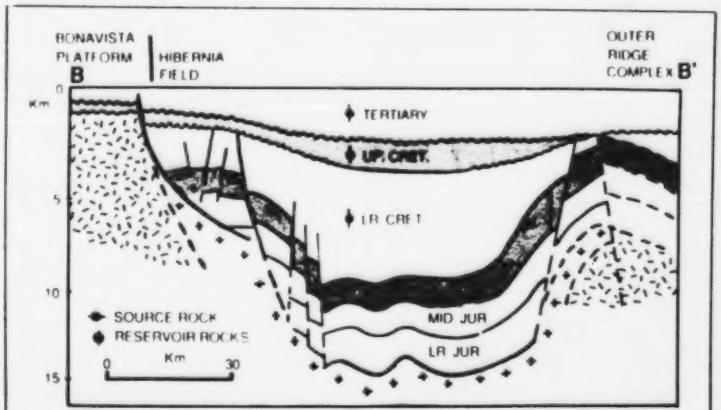


FIGURE 8. SECTION B–B' THROUGH THE JEANNE d'ARC BASIN (SEE FIGURE 6)

Grant, McAlpine and Wade

Significant Discoveries

The exploratory effort offshore Newfoundland and Labrador has resulted in 19 oil and/or gas discoveries where significant volumes of hydrocarbons have been recovered on drillstem tests. Fourteen oil and/or gas discoveries have been made on the northern Grand Banks and five gas/condensate discoveries have been made on the Labrador Shelf.

Oil Discoveries

The Hibernia geological structure is located approximately 315 kilometres east-southeast of St. John's. The discovery well, Hibernia P-15, and eight successful step-out wells have been drilled on the Hibernia structure; one well was abandoned as a dry hole. As indicated in Table 3, substantial amounts of oil have been tested from the successful step-out wells. Mobil Oil Canada, Ltd. estimates that the Hibernia geological structure may contain, at a likely case, 519 million barrels of recoverable oil. The upside potential for Hibernia is estimated at over one billion barrels.

Since the beginning of 1980, thirteen other wildcat

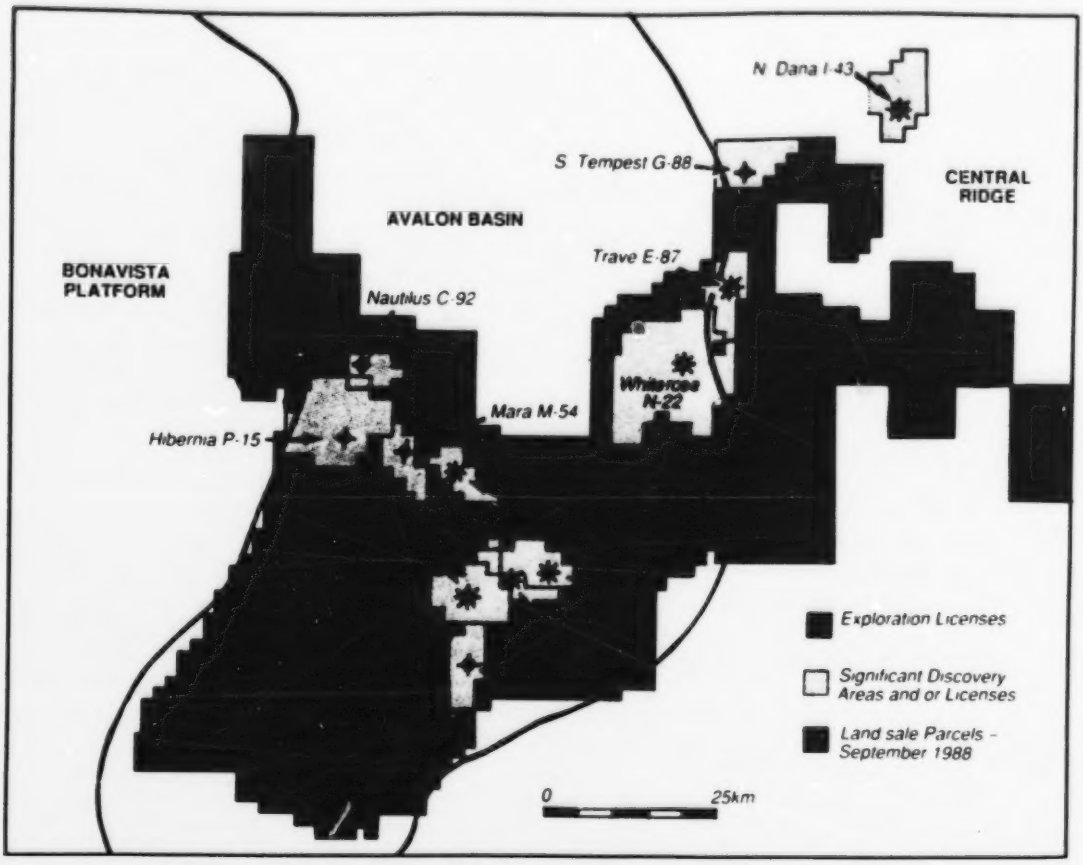


FIGURE 9. LAND HOLDINGS, SIGNIFICANT DISCOVERIES AND LAND SALE PARCELS NORTHERN GRAND BANKS, 1988.

TABLE 3. GRAND BANKS SIGNIFICANT DISCOVERIES, APPROXIMATE COMBINED FLOW RATES

Discovery and Delineation Wells	BOP/D	Discovery and Delineation Wells	BOP/D
Hibernia P-15	11,165[1]	Terra Nova E-79	N/A
Hibernia O-35	12,340	Beothuk M-05	1,700
Hibernia B-08	24,544	Whiterose N-22	1,740
Hibernia G-55	Dry	Whiterose J-49	3,400
Hibernia K-18	19,372	Whiterose L-61	436
Hibernia J-34	3,700	Whiterose E-09	N/A
Hibernia I-46	1,700	Ben Nevis I-45	1,596
Hibernia B-27	14,112	Hebron I-13	9,070
Hibernia K-14	10,300	South Tempest G-88	1,250
Hibernia C-96	5,200	Nautilus C-92	4,731
Terra Nova K-08	10,000[2]	North Dana I-43	Gas
Terra Nova K-18	Not Significant	Trave E-87	Gas
Terra Nova K-07	8,000	South Mara C-13	1,734
Terra Nova K-17	Not Significant	Mara M-54	1,400
Terra Nova I-97	5,000[3]	North Ben Nevis P-93	5,000[4]
Terra Nova H-99	7,500	North Ben Nevis M-61	5,437
Terra Nova C-09	N/A	West Ben Nevis B-75	8,700
		Fortune G-57	6,978

N/A - Not Available
1 - Flow capability greater than 20,000 BOP/D
2 - Flow capability greater than 15,000 BOP/D
3 - Flow capability greater than 10,000 BOP/D
4 - Flow capability greater than 12,000 BOP/D

wells drilled within the northern Grand Banks have resulted in significant oil and/or gas discoveries. It is estimated that between one and two billion barrels of recoverable oil could be contained in these structures. Terra Nova and Whiterose appear to be particularly promising discoveries. It is reasonable to assume that future discoveries will be made in this area, thereby increasing the estimates of discovered oil and gas resources.

Natural Gas Discoveries

In October, 1974, two natural gas finds (Bjarni and Gudrid) off the coast of Labrador were announced. Tests from these structures resulted in combined flow rates of 13 and 28 million cubic feet per day respectively, with some condensate present. Additional natural gas finds, in 1976 and 1978, at the Snorri and Hopedale structures exhibited combined flows of 9.8 million cubic feet per day and 34 million cubic feet per day respectively, with significant volumes of condensate. A large gas/condensate discovery, on a separate geological structure, was made in 1981 at North Bjarni. This structure is estimated to contain in excess of 1.5 trillion cubic feet of natural gas, but additional drilling is required for delineation.

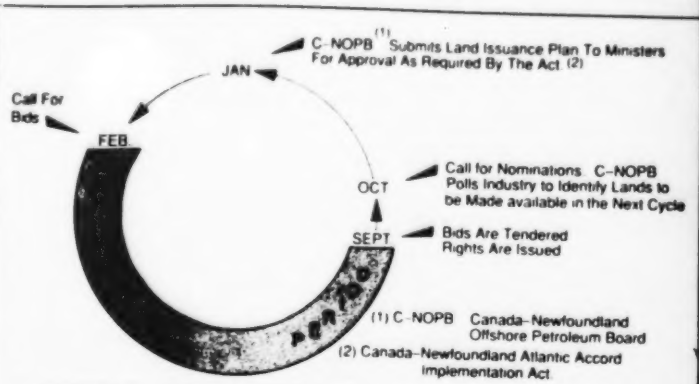
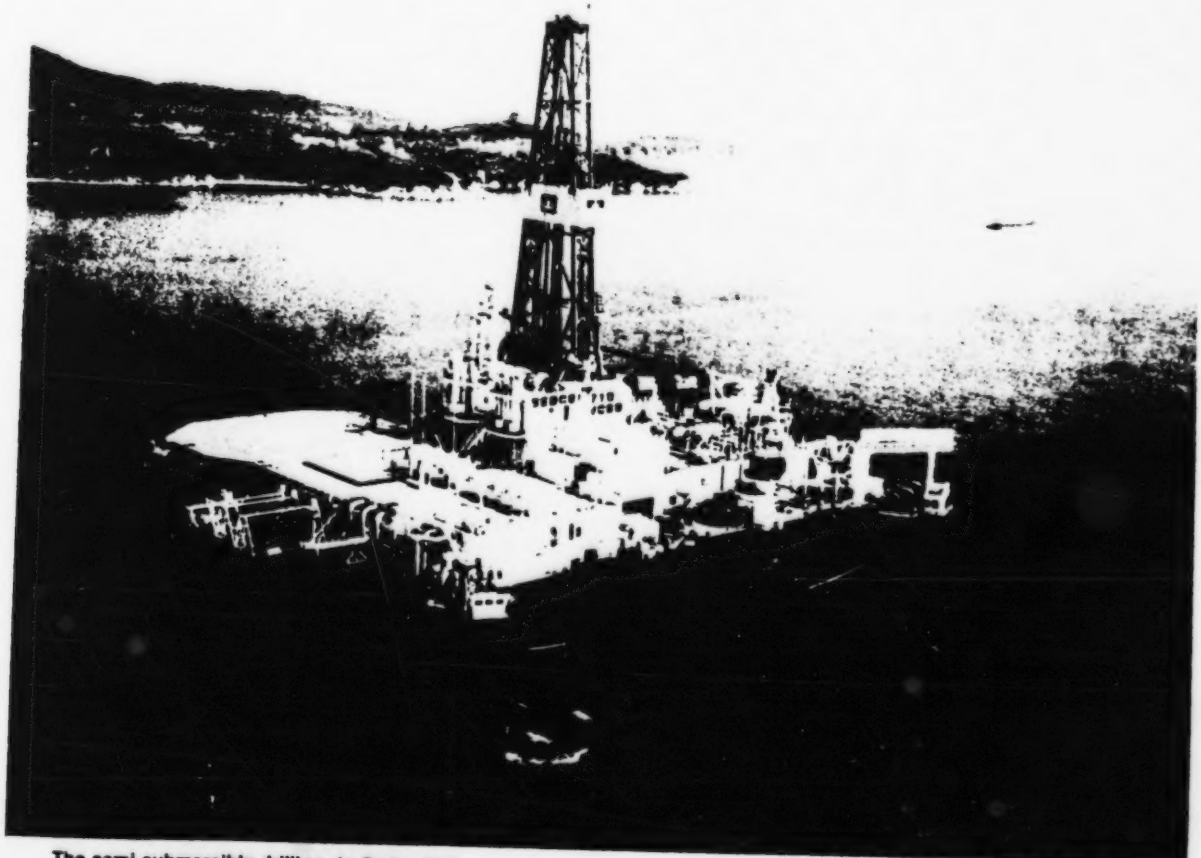

C-NOPB (1) Submits Land Issuance Plan To Ministers For Approval As Required By The Act (2)
JAN
Call For Bids
FEB
OCT
Call for Nominations C-NOPB Polls Industry to Identify Lands to be Made available in the Next Cycle
SEPT
Bids Are Tendered Rights Are Issued
PERIOD
(1) C-NOPB Canada-Newfoundland Offshore Petroleum Board
(2) Canada-Newfoundland Atlantic Accord Implementation Act

FIGURE 10. THE LAND ISSUANCE CYCLE OFFSHORE NEWFOUNDLAND AND LABRADOR

Future Activity

Under the terms of existing Exploration Licences, seven new wells are required to be drilled by the end of the first quarter 1990 in order for operators to meet their obligations. The recent downturn in offshore exploration relates directly to uncertainties about the future of oil prices and reduced federal incentives. Exploration activity over the next few years could increase: as a result of a rise in oil prices; new field



The semi-submersible drilling rig Sedco 710.

Petro-Canada Inc.

development; new exploration licence requirements; new incentive programs; or any combination of the above.

Petroleum Interests

Over the last two decades fourteen drilling operators have been active in the offshore area. As of May 1988, five groups of companies hold rights to 712,896 hectares of the continental margin in the form of seven Exploration Licences, and ten Significant Discovery Licences.

On March 11, 1988 the Canada-Newfoundland Offshore Petroleum Board, with the appro. al of the federal and provincial energy ministers, issued a Call for Bids for licences on 258,141 hectares of crown lands. The tracts being offered have been selected from areas which were nominated by industry in a previous call for nominations. The closing date for bids is September 28, 1988. The rights issuance procedure, as illustrated in Figure 10, is cyclical in nature, and is designed to allow industry input through the nomination process, as well as ample time for pre-sale evaluations.

The issuance of rights is expected to increase drilling activity in two ways. Firstly, companies may wish to evaluate the potential of lands for which they currently hold exploration rights in order to estimate the value of adjacent areas and formulate their bids. Secondly, the terms for awarding the new rights will contain requirements to drill wells.

Estimated Offshore Petroleum Resources of Newfoundland

Estimates prepared by the Geological Survey of Canada in 1983, suggested a combined crude oil potential for the province's continental margin of approximately 10 billion barrels. This total far exceeds the total remaining conventional crude oil reserves of Canada. The Geological Survey's estimate of the natural gas in the region amounts to around 53 trillion cubic feet.

It is conservatively estimated that Hibernia has recoverable oil reserves of over half a billion barrels. Terra Nova and the other significant discoveries to date represent well over one billion barrels of oil potential. The exploration and delineation drilling that has taken place to date on the continental margin of the Province amounts to only 130 wells. This compares modestly with the intensive drilling activities in other offshore areas of the world. However, the success rates have been impressive; 108 exploratory wells have resulted in 19 significant discoveries - a ratio of 1 to 5.7; in the area surrounding the Hibernia discovery the ratio has been one out of two.

While the northern Grand Banks continues to be the most prolific oil and gas region of the Newfoundland continental margin, increased exploration is required in other less explored regions, before the true potential of the Newfoundland offshore can be adequately assessed.

ONSHORE

The Island of Newfoundland represents the northeastern extension of the exposed Appalachian Mountain System which was continuous with the Caledonian Mountain system of Europe before the opening of the Atlantic Ocean. Petroleum potential on the Island is restricted to a discrete geologic region known as the Western Platform (Figure 11).

The Western Platform covers an area of about three million hectares and contains three distinct successions of sedimentary rocks. The first consists of a Cambro-Ordovician carbonate platformal sequence that was deposited along the ancient continental margin of eastern North America. In some areas these rocks are overlain by transported sediments of approximately the same age which were thrust westward as a result of crustal shortening. Both of these sedimentary successions exhibit suitable source, reservoir and trapping characteristics for the generation and accumulation of hydrocarbons.

To date exploratory drilling in the region has been concentrated in the upper, transported sequence, but it is possible that the large hydrocarbon traps may be found in the underlying, non-transported formations, which have experienced only minor deformation over time.

The third major sedimentary succession of the Western Platform, Carboniferous sediments (Figure 11) are believed to have accumulated within a large area of subsidence that extends from the Bay of Fundy to northern Newfoundland. The presence of strata rich in organic matter and in coaly and bituminous shales indicates that hydrocarbon source material is present. Surface examinations demonstrate that a variety of structural and stratigraphic trapping mechanisms could exist within these basins. It is relevant to note that the only producing oil and gas field in the Atlantic region, Stony Creek in New Brunswick, occurs in Carboniferous strata.

In summary, the three sedimentary rock groups that exist within the Western Platform all possess the ingredients necessary for hydrocarbon accumulations. The existence of oil seeps and the numerous oil and gas shows throughout the Western Platform demonstrate that hydrocarbons have, indeed, been generated. The offshore extensions of these rocks, are

FIGURE 11. GEOLOGICAL MAP OF THE HUMBER ZONE (WESTERN PLATFORM) IN WESTERN NEWFOUNDLAND

James et al, in press

geologically similar and have substantial potential to contain hydrocarbons.

The western portion of the Island has long been recognized as an area having petroleum potential and in fact the first drilling operation in the Province took place onshore in that area more than 100 years ago. Since then more than 50 wells have been drilled without the benefit of seismic control and over half of them encountered shows of oil and/or gas.

New Onshore Regulations

In an effort to encourage exploration in the Province's onshore areas, the Department of Energy has recently developed new onshore petroleum regulations. The previous regulations, which were designed in 1977 mainly to administer the offshore, contained certain clauses which were considered onerous to companies that would explore for the smaller fields that are thought to exist in the onshore. The new Newfoundland and Labrador Onshore Petroleum Regulations, which are expected to be promulgated in 1988, are intended to enhance the attractiveness of exploring the onshore area.

III DEVELOPMENT PROSPECTS

Of the 19 significant hydrocarbon discoveries made offshore Newfoundland, Hibernia was the first to demonstrate commercial potential. This field, with estimated recoverable oil reserves of at least 519 million barrels, also contains an estimated 2.6 trillion cubic feet of associated natural gas in place.

Terra Nova is the latest field to exhibit potential for commercial development. Petro-Canada's initial estimates of recoverable oil reserves were between 70 and 130 million barrels, but recent results from the delineation program indicate the reserves are at least 150 million barrels, with an upside potential considerably in excess of this total.

In addition to Terra Nova and Hibernia, there are seven other significant discoveries which have a combined resource potential of over one billion barrels and represent an important future supply.

To date, a development plan has been prepared for the Hibernia project only. Preliminary outlines of Petro-Canada's plans for Terra Nova have been released and further field delineation is being carried out. A formal development plan is expected in 1989.

THE HIBERNIA PROJECT

Mobil Oil Canada, Ltd. and its partners in the Hibernia Project, are currently negotiating the fiscal terms of the project with both levels of government. With an estimated capital cost of $5.0 billion (1986) and an estimated annual operating cost of $500 million, the Hibernia project is the largest single project in Newfoundland history and one of the largest in Canadian history.

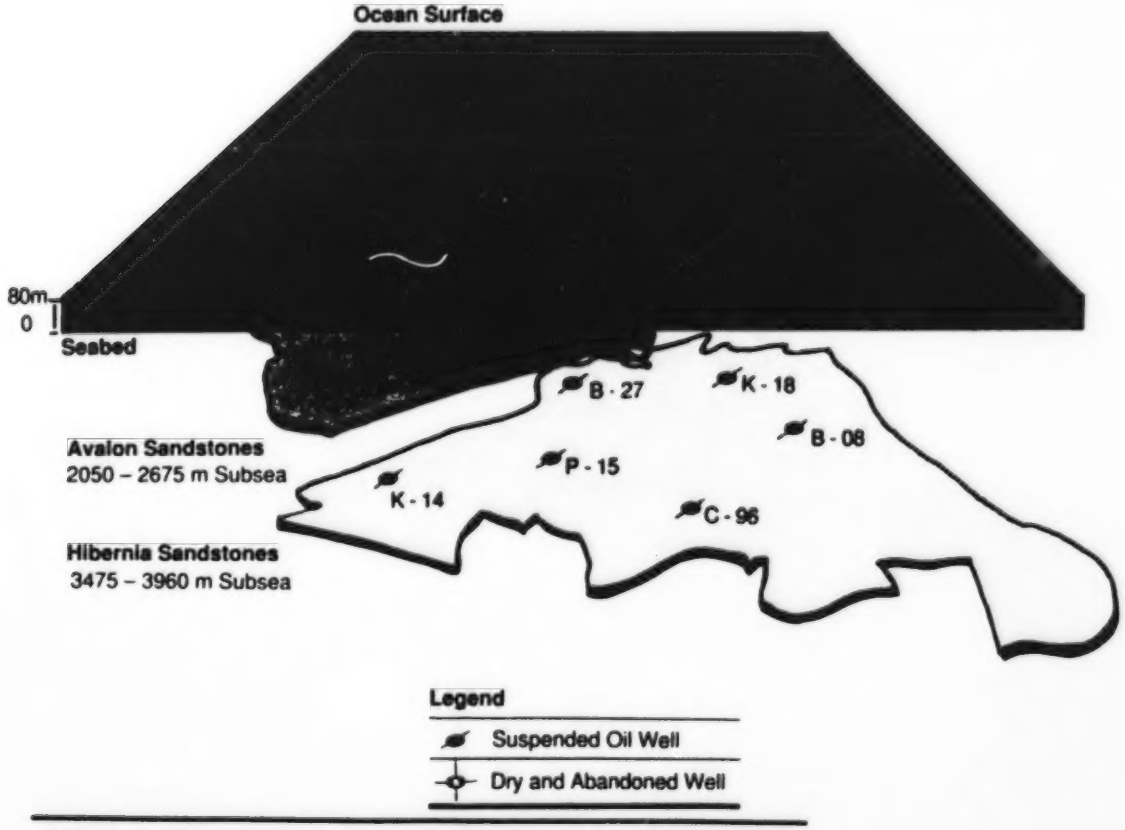


FIGURE 12. HIBERNIA FIELD – SCHEMATIC DIAGRAM OF MAJOR RESERVOIRS

Mobil Oil Canada, Ltd.

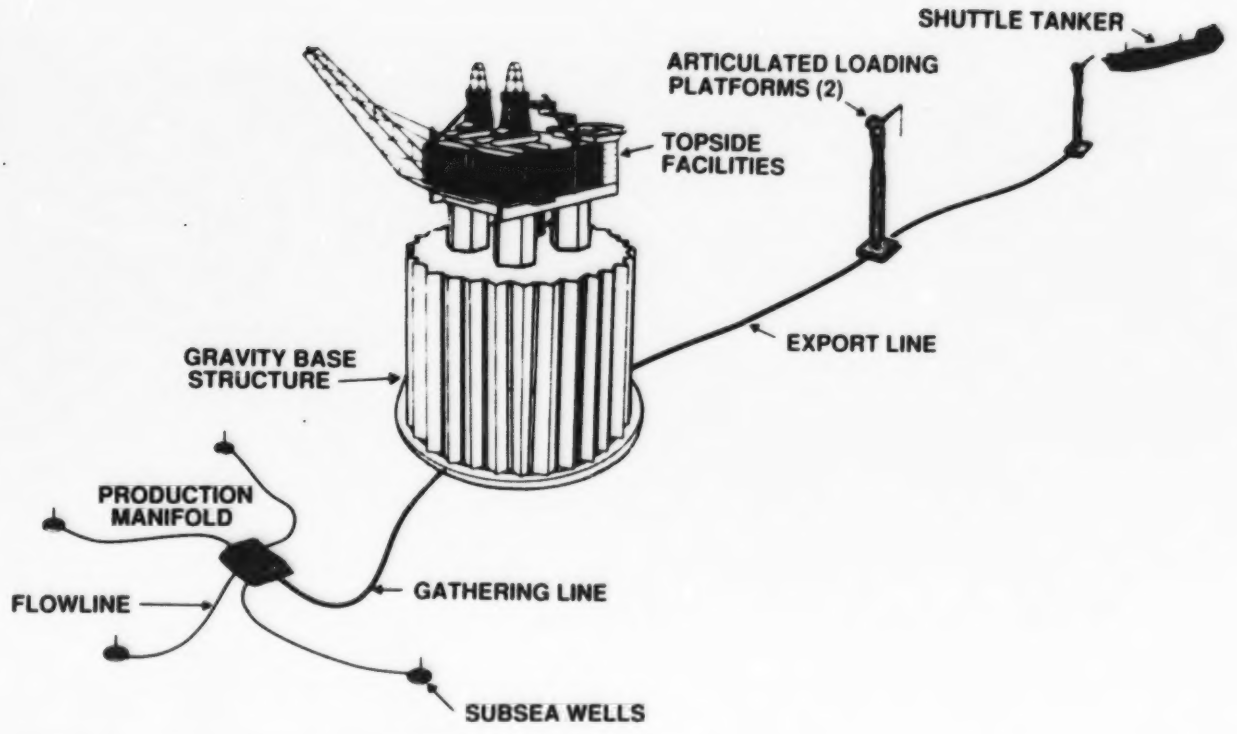
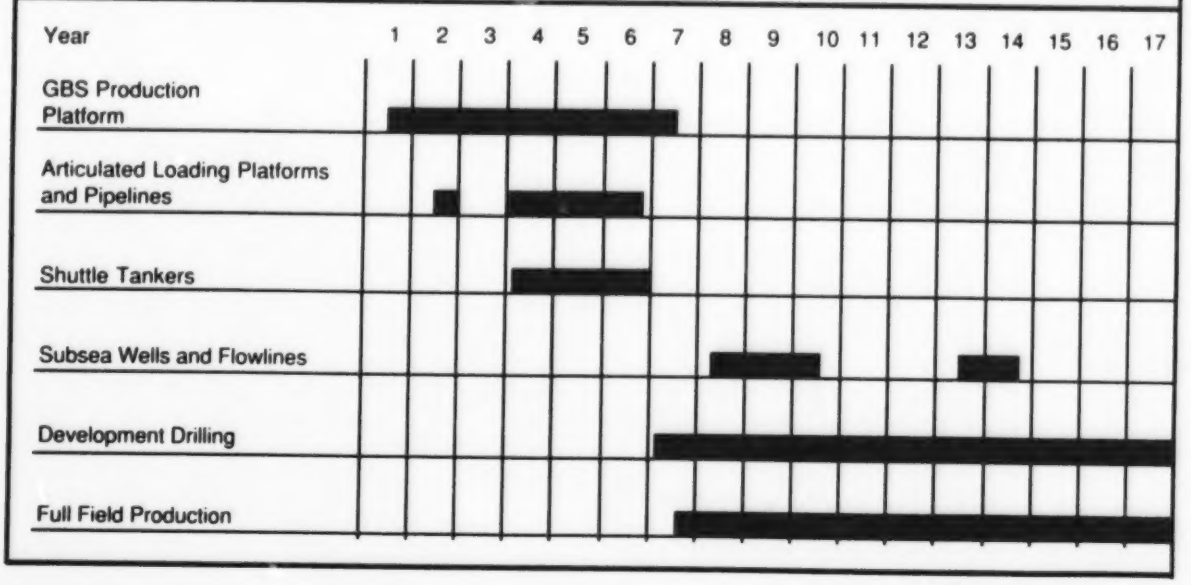


FIGURE 13. HIBERNIA FIXED PRODUCTION SYSTEM COMPONENTS

Mobil Oil Canada, Ltd. (E.I.S. – 1985)

TABLE 4. HIBERNIA PROJECT SCHEDULE, FIXED PRODUCTION SYSTEM


Year
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
GBS Production Platform
Articulated Loading Platforms and Pipelines
Shuttle Tankers
Subsea Wells and Flowlines
Development Drilling
Full Field Production

Mobil Oil Canada, Ltd. (E.I.S. – 1985)

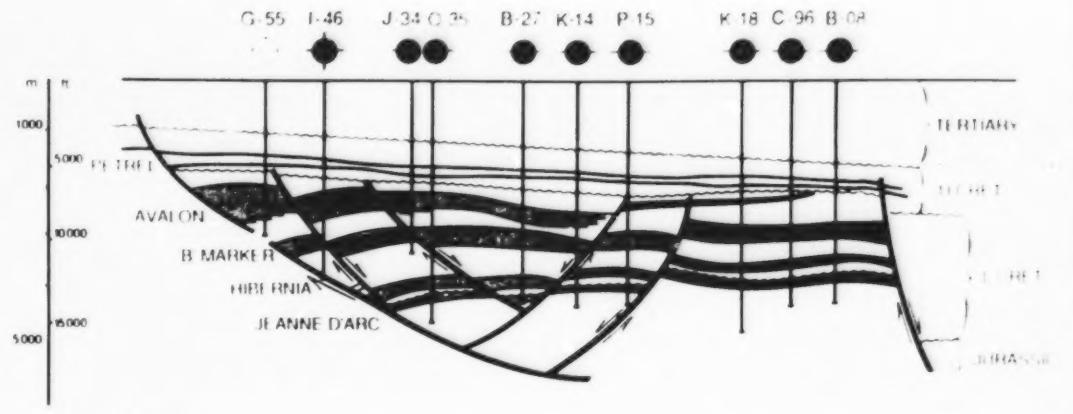


FIGURE 14. HIBERNIA FIELD GEOLOGIC CROSS SECTION

The Hibernia Field is located approximately 315 kilometres east-southeast of St. John's in water depths ranging from 76 to 86 metres.

The development plan, as submitted by Mobil on September 15, 1985, and conditionally approved by the Canada-Newfoundland Offshore Petroleum Board, contemplates total development of the Hibernia Sandstones and possibly a portion of the Avalon Sandstones.

The proposed production system (see Figure 13) is designed to produce oil at a nominal rate of 150,000 barrels per day (average of 110,000 barrels per day) utilizing up to 49 production wells, both platform and subsea. The production platform will consist of topside facilities mounted on a concrete gravity base structure (GBS). The GBS will include three sections: a concrete slab base, a caisson reaching from the seabed to approximately five metres above the mean low water level, and four shafts extending above the caisson to support the deck structure. The deck will contain the topside facilities including drilling, production, treatment, gas and water injection utilities and accommodation modules. The crude oil will be treated on the GBS to remove water and gas, and stored within the structure for later transport to market by shuttle tankers. The transportation system will consist of subsea pipelines to two articulated loading platforms, and anticipates the use of three 120,000 dwt shuttle tankers.

Plans are to construct the GBS, assemble the topside facilities and mate the topsides to the base at a sheltered deep water location in Placentia Bay, Newfoundland. After construction, the completed facility will be towed out and installed at the Hibernia Field.

The development schedule prepared by Mobil indicates that production will begin five to six years after the operation commences.

...the Hibernia project is the largest single project in Newfoundland history and one of the largest in Canadian history.

Mobil estimates that the Hibernia reservoir contains a recoverable oil reserve of 447 million barrels as well as a total in-place gas reserve of 2.3 trillion cubic feet. The operator does not plan to produce gas for sale, but proposes to re-inject the gas into the reservoir for pressure maintenance.

The Avalon reservoir, according to Mobil's estimation, contains a recoverable oil reserve of 75 million barrels as well as a total in-place gas reserve of 0.3 trillion cubic feet in what they perceive to be the developable area.

The National Energy Board in its latest report estimates that Canada's conventional crude reserves amounted to about 4.7 billion barrels. With national production of crude running at about 600 million barrels per year, the estimated recoverable crude reserve amounts to about eight years supply.

In 1987, Canada imported about 400,000 barrels of crude per day of which 390,000 barrels was delivered to Eastern Canada.

It is obvious therefore that in terms of additions to the nation's crude reserves, Hibernia represents a substantial contribution. Mobil estimates that Hibernia will provide production averaging 110,000 barrels per day or about 30 percent of present imports into the eastern region. This new source of supply for Canada will therefore benefit the national balance of payments by hundreds of millions of dollars annually.

In addition to its national supply importance, Hibernia will stimulate a great amount of economic activity in Canada in general and in the Province of Newfoundland in particular. Of the estimated five billion dollars capital investment involved in the project, more than half will be spent in Canada and about a quarter in Newfoundland. Associated investment will benefit all provinces in the eastern region.

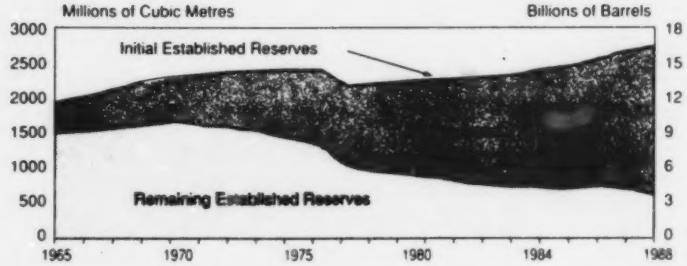


FIGURE 15. ESTABLISHED RESERVES OF CONVENTIONAL CRUDE OIL, CONVENTIONAL AREAS

Source: National Energy Board

Note: 1986 extension from latest NEB information–April, 1988

The project will generate a tremendous amount of new employment during its development phase. It is estimated to create 21,500 direct person years of employment of which 14,500 will be in Canada and 9,500 in Newfoundland. The impact of this new employment will be dramatic, particularly in the eastern provinces, with their traditionally high levels of unemployment.

During the production phase of this project, direct annual employment will amount to about 1,100 full time jobs.

In addition to the above economic implications of the Hibernia project, it should be noted that a number of major investments derived from the $300 million Canada-Newfoundland Offshore Development Fund established under the Atlantic Accord are now in process.

The development plan for the Terra Nova oil field is expected in 1989.

THE TERRA NOVA PROJECT

On March 9, 1987 the operator of the Terra Nova Field, Petro-Canada, announced plans to develop the Field, with first oil production to commence in 1991. More recently, it was indicated that the earliest possible date for the commencement of production would be 1993. This is due to delays in delineation drilling and the anticipation of a longer development period. The revised development period is the result of a substantial increase in estimated reserves, based upon positive results from recent delineation drilling.

The Terra Nova Field is located 35 kilometres southeast of Hibernia. The discovery well, K-08, drilled in 1984 in 94 metres depth of water, tested oil at a rate of 10,882 barrels of oil per day. The eight delineation wells which have been drilled to date have helped confirm the extent of the field but additional delineation is required. The recent H-99 well encountered excellent reservoir in the northeast portion of the field. A subsequent well, Terra Nova C-09 was drilled 1.2 kilometres north of the original discovery well to help define the northern extent of the field. This well, although reaching total depth, was suspended so that an additional well could be completed at the E-79 location. This well, the eighth to be spudded, is located 5.5 kilometres east of the C-09 location and 3 kilometres east of the H-99 well. Positive results from these wells have helped to confirm the very substantial reserve base of the Terra Nova Field. Petro-Canada expects that at least one additional well will be required to delineate this discovery.

Results of the delineation program, although not completed, suggest that the original reserve estimate of 70 million barrels has at least doubled.

The operator now expects to be in a position to make a decision on proceeding with development, and to seek the necessary regulatory approvals by 1989. Following the new timetable, a final decision to begin construction of a floating production system could be made by 1991, leading to initial oil production two years later. An average production rate greater than 45,000 barrels of oil per day is possible from the Terra Nova Field.

Petro-Canada has identified two alternative floating production systems for the Terra Nova Field: shipshaped and semi-submersible. Both systems involve the use of shuttle tankers to deliver the crude for refining.

The planned development of the Terra Nova discovery represents a first step in the exploitation of a

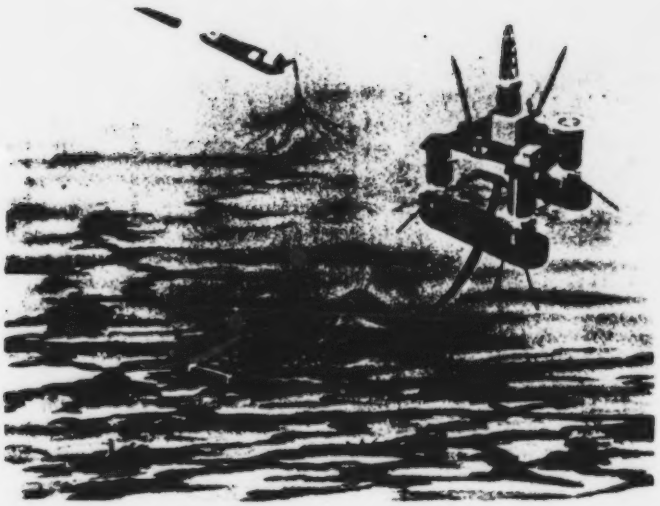


FIGURE 16. SEMI-SUBMERSIBLE-BASED PRODUCTION CONCEPT FOR THE TERRA NOVA FIELD

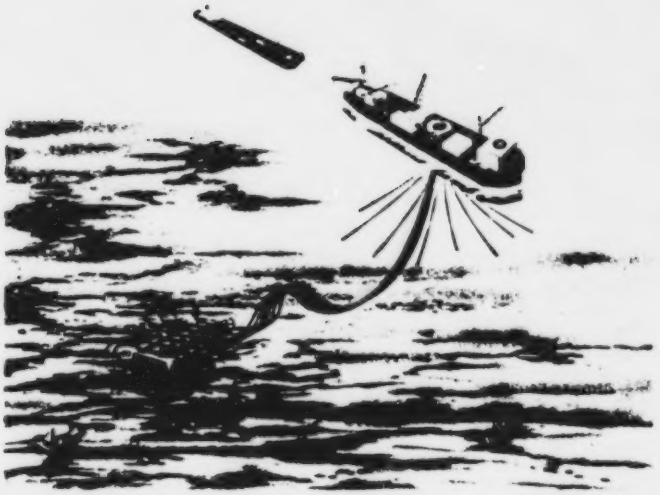


FIGURE 17. SHIP-BASED PRODUCTION CONCEPT FOR THE TERRA NOVA FIELD.

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TABLE 5. TERRA NOVA PRELIMINARY PROJECT SCHEDULE

Year	1	2	3	4	5
Delineation drilling					
Reservoir evaluation					
Preliminary engineering					
Regulatory approvals					
Project preparation					
Design and construction					
Development drilling					
Oil production					
Decision milestones ▼					

TABLE 6. TERRA NOVA ESTIMATED DEVELOPMENT COSTS (Original Estimates, 1987 Cdn. $ Millions)

	GRABEN ONLY	GRABEN PLUS EAST FLANK
Delineation Drilling	45	45
Development Drilling	145	290
Production Facilities	300–400	500–600
Preliminary Engineering	10	10
Project Preparation	20	20
TOTAL	520–620	865–965

Petro-Canada Inc.

number of smaller fields in the Newfoundland offshore area.

At this time, while Petro-Canada is evaluating alternative production systems, there are no firm estimates as to investment levels or potential benefits to be derived from the project. The company has, however indicated that development costs could range from $500 million to around $1 billion, depending on the extent of the development (Table 6).

OTHER DEVELOPMENT PROSPECTS

Apart from Terra Nova and Hibernia, seven other significant discoveries on the Grand Banks have considerable potential to add to Canada's diminishing oil reserves. While further delineation of these fields remains to be done, recent studies indicate that the cost of producing oil from these fields would be competitive within the context of Canadian frontier petroleum development and within the next decade.

The estimates of upside resource potential of these fields indicate their importance for the future:

Whiterose	300 million barrels
North Ben Nevis	150 million barrels
Hebron	150 million barrels
Ben Nevis	150 million barrels
Fortune	150 million barrels
South Tempest	180 million barrels
Nautilus	70 million barrels

Before these discoveries can be developed, their reserve estimates have to be confirmed by further delineation. Cost effective exploitation of these fields calls for some increase in world oil prices but the most recent National Energy Board report on conventional oil reserves in Canada, indicates the relative urgency of establishing alternative supplies within the country in the interests of energy security and of the national economy. In this context, these discoveries will become increasingly important development prospects.

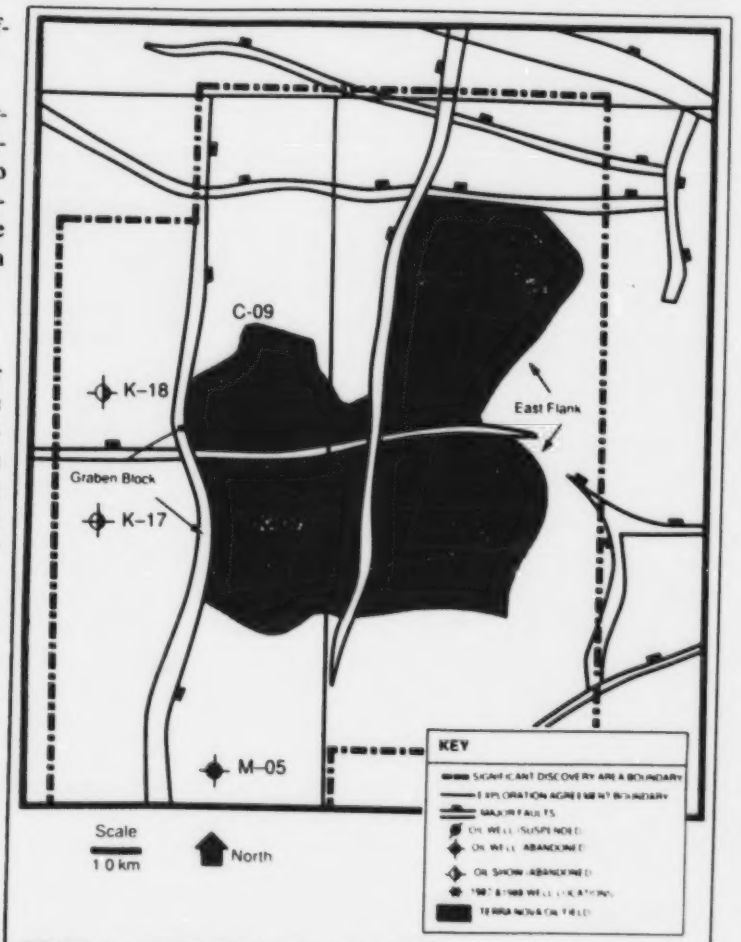

FIGURE 18. TERRA NOVA WELL LOCATIONS

Other discoveries, apart from Hibernia and Terra Nova, have considerable potential in their own right.

IV REFINERY OPERATIONS

The Come-by-Chance refinery restarted operations in August 1987, following its acquisition by Newfoundland Energy Limited from Petro-Canada in December 1986.

The refinery, which has a maximum throughput of 100,000 barrels per day, has the capability of producing the full range of petroleum products from liquified petroleum gases to heavy fuel oil. Currently the bulk of its output is exported to the United States. Minor quantities are being marketed within the Province and it is expected that local sales will increase as production moves towards full capacity. Additional investment is scheduled for 1988 and should improve substantially the operational efficiency of the refinery. A new Isomax unit will be installed by mid-year and will serve to increase production of jet fuels and distillates.

The reactivation of the refinery is a major new industrial development within the Province. Apart from its immediate impact on employment and the direct and indirect benefits involved in its restoration and improvements, it opens up real possibilities for ancillary industries in the future.

The availability of product for the local market represents an important new competitive element which should operate to the benefit of the Newfoundland consumer.

Sheldon LeGrow

APPENDIX A

SUMMARY OF LEGISLATION RELATING TO PETROLEUM EXPLORATION, DEVELOPMENT AND PRODUCTION

I LEGISLATION

The following legislation governs petroleum matters in the Province and is the responsibility of the Department of Energy.

Department of Energy Act, (1987)

This Act established the new Department of Energy and gave the Minister responsibility for:
(a) the supervision, control and direction of all matters relating: (i) to oil and natural gas (ii) to energy, including electrical power, howsoever generated and, (iii) to the administration of the province's energy related Acts and all regulations, orders etc., passed under those Acts which have not been assigned to any other minister;
(b) liaison with the Government of Canada or any department or agency of the federal jurisdiction;
(c) liaison with the Government of any province or any department agency under the jurisdiction of such province;
(d) monitoring of all relevant energy developments;
(e) development of recommendations for appropriate changes in the energy laws of the province.

The Canada-Newfoundland Atlantic Accord Implementation (Newfoundland) Act (1986)

The Canada-Newfoundland Atlantic Accord Implementation (Newfoundland) Act received Royal Assent on June 17, 1986 (Chapter 37, RSN, 1986) and was proclaimed in force on April 4, 1987. The Act implements the Atlantic Accord, the agreement between the Government of Canada and the Government of Newfoundland and Labrador on offshore petroleum resource management and revenue sharing. Certain fundamental decisions relating to land issuance, extraordinary powers and development plan approval are subject to the approval of the Provincial Energy Minister.

The Petroleum & Natural Gas Act (1970)

In those areas subject to provincial jurisdiction, the Petroleum and Natural Gas Act (1970) declares Crown Petroleum to be vested in Her Majesty in right of the Province; defines the title documents (licenses, permits and leases) which may be issued to oil exploration companies; and outlines the regulatory- making powers of the Lieutenant-Governor in Council with respect to land tenure, exploration, production, rental fees, royalties and reporting requirements.

The Petroleum Corporation Act (1980)

The Petroleum Corporation Act (1980) established a Crown owned company (Newfoundland and Labrador Petroleum Corporation) with authority for exploration, development, refining and marketing of petroleum. The Act was proclaimed in force October 22, 1980.

II REGULATIONS (EXISTING)

The following regulations govern petroleum matters in the Province and are the responsibility of the Department:

The Newfoundland and Labrador Drilling Regulations, (1982)

The Newfoundland and Labrador Drilling Regulations, 1982, apply to operators who drill wells under the Petroleum and Natural Gas Act and as such are still in effect with respect to onshore areas of the Province.

III REGULATIONS (PROPOSED)

The Newfoundland Royalty Regulations

The Newfoundland Royalty Regulations have not been finalized.

The Newfoundland and Labrador Petroleum Geophysical Regulations, (Onshore) (1988)

The Newfoundland Petroleum Geophysical Regulations for application in the onshore area, are in draft form.

Newfoundland and Labrador Petroleum Regulations, (Onshore) (1988)

The Newfoundland and Labrador Petroleum Regulations, 1977, passed pursuant to the Petroleum and Natural Gas Act were repealed in the spring of 1986, and a new draft with specific application to onshore areas of the Province has been developed. These regulations will describe land tenure mechanisms in detail and will include bidding procedures and development plan requirements.

Petroleum Products Demand Restraint Regulations

In the event of a serious national petroleum supply disruption, it will be necessary to implement a number of measures designed to restrict demand for petroleum products - particularly gasoline.

REGULATIONS UNDER THE CANADA-NEWFOUNDLAND ATLANTIC ACCORD IMPLEMENTATION (NFLD.) ACT

(i) Canada-Newfoundland Oil and Gas Spills and Debris (Nfld.) Liability Regulations

These regulations prescribe the applicable limits of absolute liability for damages or actual loss incurred as a result of a spill or debris.

(ii) Newfoundland Offshore Area Registration Regulations

These regulations establish a registry system to permit the registration of transfers of ownership and encumbrances on title, as allowed for under the Act.

(iii) Canada-Newfoundland Offshore Area Operations Regulations

These regulations set out conditions for obtaining an operating licence, authorization of exploratory or development-related work, and for reporting an oil spill.

(iv) Newfoundland Offshore Petroleum Drilling Regulations

These regulations establish the process for approval, regulation and inspection of drilling programs in the offshore area.

(v) Petroleum Occupational Safety and Health Regulations Offshore Newfoundland

These regulations concern the occupational safety and health of employees employed in respect of the exploration or drilling for or the production, conservation, processing or transportation of oil or gas in the offshore area.

(vi) Canada-Newfoundland Offshore Area Diving Regulations

These regulations have been designed to ensure the safety of individuals engaged in diving operations conducted in connection with the exploration and the production of oil and gas.

(vii) Canada-Newfoundland Offshore Production and Conservation Regulations

These regulations concern safety, conservation practices and the prevention of pollution in operations undertaken for the production of oil and gas. The proposed regulations will provide specifically for the authorization, regulation, and the safety of production operations in the offshore area.

(viii) Canada–Newfoundland Offshore Area Production Installation Regulations

These regulations establish design and performance criteria for the various components of the production installation superstructure, to ensure that production operations will be carried out in as safe an environment as possible.

(ix) Canada-Newfoundland Offshore Pipeline Regulations

These regulations govern the safety and inspection aspects of the construction and maintenance of offshore pipelines from the well to a central gathering point.

(x) Canada-Newfoundland Offshore Oil and Gas Area Geophysical Regulations

These regulations provide specifically for the authorization and regulation of geophysical operations and ensure the safety of those operations in the offshore area.

(xi) Canada-Newfoundland Offshore Area Survey Regulations

These regulations are required to reflect the creation of a new satellite survey system which allows for a more accurate method of surveying in the offshore area.

(xii) Canada-Newfoundland Offshore Area Issuance Regulations

These regulations provide for the conditions and procedures related to the issuance of petroleum rights in the Newfoundland offshore area.

(xiii) Canadian Ownership Rate Regulations

These regulations establish the determination of the level of Canadian ownership that is required before a Production Licence may be issued.

APPENDIX B

OFFSHORE DEVELOPMENT FUND
SUMMARY OF MAJOR PROJECTS APPROVED TO DATE

Centre for Earth Resources Research

The Centre, now under construction at Memorial University, will provide high level education, research and development capability in the earth resources sector including offshore hydrocarbons. The estimated cost is $25 million. Memorial University already has the largest geoscience department in Canada. The new Centre will encourage, and assist in, the training of highly skilled individuals in the earth resources disciplines and support offshore related research and development. It will maintain liaison with other agencies and industries engaged in onshore and offshore earth science developments. It will contribute greatly to the province's "centres of excellence" policy in education, training, research and development related to cold ocean and marine environments.

Offshore Survival Centre (Marine Institute)

This centre was opened in November, 1985 and the new funding, amounting to $5 million, will provide improved safety and fire-fighting training and facilities in conjunction with the Marine Emergency Duties program. It will feature a strong applied research and training capability in recognition of emerging technology to facilitate offshore exploration and development.

Petroleum Technology Training Program

This $21 million program, which will be administered by the Department of Career Development and Advanced Studies, will involve upgrading of the existing post-secondary technology training facilities and programs of relevance to the offshore petroleum industry. It will also establish new programs and facilities. Priority areas will include engineering technology, welding technology, electrical and electronics technology and heavy equipment operator training.

Enhancement of Offshore Fabrication of the Marystown Shipyard

Two million dollars have been made available for upgrading of the shipyard's engineering and managerial capabilities and to identify specific areas where its physical facilities need to be improved to qualify for Hibernia fabrication work. A further $18 million have been approved in principle for expansion and upgrading of facilities when the specific needs have been established. These funds will be administered by the Department of Development and Tourism.

Institute for Marine Dynamics Wave Generator

The Fund is contributing $3.5 million to this system which will cost $10.6 million in total. The federal government, through the National Research Council will provide the balance. The wave maker will be the most advanced in the world and the total system will be one of the largest in the world. It will provide industry with a broad range of realistic conditions under which to study offshore exploration and production systems and to test the behaviour of all kinds of offshore structures and vessels. This facility will put Canada and Newfoundland in the forefront of world research in the effects of the marine environment on ships and offshore structures. It will be located on the campus of Memorial University.

Super Puma Helicopter Flight Simulator Centre

The Offshore Development Fund is contributing $4.2 million to this training centre which will cost $14.6 million. CHC Helicopter Corporation will provide $2.1 million as an equity contribution and the Government of Newfoundland and Labrador will be providing an $8.3 million loan guarantee. The advanced nature of the simulator's capabilities will make the Centre an important world training centre. It will be located in St. John's.

APPENDIX C

GLOSSARY

BOP/D - Barrels of oil per day.

CALEDONIAN MOUNTAIN SYSTEM
- A very old mountain system in North West Europe which formed during the Lower Paleozoic era.

CAMBRO–ORDOVICIAN
- Collectively refers to rocks formed during the Cambrian and Ordovician periods.

CARBONIFEROUS
- The fifth period of the Paleozoic era; from 345 to 280 million years ago.

CENOZOIC - The latest of the four eras into which geologic time is divided; from 65 million years ago to historic times.

CONDENSATE
- Liquid hydrocarbons produced with natural gas which are separated from the gas by cooling and various other means. Condensate generally has an A.P.I. gravity of 50° to 120° and is clear, yellow or bluish in color.

CRETACEOUS
- The third and latest of the periods included in the Mesozoic era; from 135 to 65 million years ago.

DRILLSTEM TEST
- A method of obtaining a sample of fluid from a geologic formation using a "formation–test tool" attached to the drillstem. The tool consists of a packer to isolate the section to be tested and a chamber to collect a sample of fluid. If the formation pressure is sufficient, fluid flows into the tester and up the drill pipe to the surface.

FAULT - A fracture in rock along which there has been an observable amount of displacement.

JURASSIC - The second and middle period of the Mesozoic era; from 195 to 135 million years ago.

MESOZOIC - The second (middle) major geological era; from about 230 to 65 million years ago.

MMCF/D - Millions of cubic feet per day.

RIFT SYSTEM
- A system of valleys associated with the subsidence of an area that occurs prior to initiation of seafloor spreading.

SEAFLOOR SPREADING
- The process, according to the theory of continental drift, by which continents drift apart. The submerged areas between the continents then form the ocean basins.

TERTIARY - The earlier of the two geologic periods comprising the Cenozoic era; from 65 to 2 million years ago.

TOPSIDE FACILITIES
- The structure above the water on a production platform.

WILDCAT - Refers to a well to be drilled in an unproven area far from a producing well.